LE
3
T6 U56

Medical J

University of Toronto
Library, Serials Dept.
Toronto, Ont.
M5S 1A5

University of Toronto April 1977

medical journal
university of toronto

Established December 1923
An Undergraduate Publication

Volume LIV
Number 5

STAFF

EDITORS-IN-CHIEF: Alan Ing 7T8, Susan Ross 7T9

MANAGING EDITORS: Ugo Gizzi 7T8, Molly Wills 7T9

CONTRIBUTING EDITORS: Frances Frankenburg 7T8, Kirby Hsu 7T9, Nick Rizos 7T8, David Arnold 7T9

RESOURCES: Jeffrey Davidson 8T0, Joseph Chu 7T8

ISSUE EDITORS:
DECEMBER: Molly Wills 7T9
JANUARY: Kirby Hsu 7T9
FEBRUARY: Susan Ross 7T9
MARCH: Nick Rizos 7T8
APRIL: Alan Ing 7T8

ART, GRAPHICS, and COVER: Lynn Waldo, AAM, Robin Hamilton, AAM

THE COVER: A DaVinci anatomical work introduces this issue's theme, the Musculoskeletal System.

CONTENTS

Additional Challenges for Medical Students	99	Paul E. Lacy
Prognostic Indicators in the Treatment of Ankle Fractures	100	J.D. Gollish
Frequency of some Abnormalities in the Lumbosacral Spine Evaluated by Pre-Employment Roentgenograms	103	R. Anderson W.M. Brown
Art in Medicine	106	Margo Siminovitch
Pulmonary Tantalum Angiography	113	Bruce Pollock Melvyn Goldberg
Historical Perspective of Medicine	116	Joseph Chu

PATRONS

For their generous financial support (with its consequent psychological boost) we would like to extend our sincere thanks to the following individuals:

Dr. Ulo Ambus, Toronto
Dr. Michael A. Baker, Toronto
Dr. B. Lynn Beattie, Toronto
Dr. John A. Beswick, West Hill, Ont.
Dr. J. L. Brayley, Mississauga
Dr. C. B. Brown, Toronto
Dr. Donald J. Currie, Toronto
Dept. of Surgery, University of Toronto
Dr. Rodney S. Fowler, Toronto
Dr. F. H. Fraser, Burlington, Ont.
Dr. A. Freiberg, Toronto
Dr. Irvin Gollish, Toronto
Dr. A. L. Halpern, Mamaroneck, N.Y.
Dr. W. J. Horsey, Toronto
Dr. Mary Jackson, Toronto
Dr. Fred L. Johnson, Hamilton
Dr. Ben I. Johnstone, Michigan
Dr. James H. Kerr, Don Mills, Ont.
Dr. H. F. King, Midland, Ont.
Dr. R. G. Kunkel, Noranda, Quebec
Dr. P. B. Lindsay, Woodstock, Ont.
Dr. L. Loach, Toronto
Dr. Bruce Marshall, St. Mary's, Ont.
Dr. J. F. Murray, Toronto
Dr. D. V. McFarlane, Toronto
Dr. R. H. Penney, Toronto
Dr. C. Phillips Rance, Toronto
Dr. Robert B. Salter, Toronto
Dr. Ruth Sky, Toronto
Dr. D. A. Stewart, Toronto
Dr. Marjorie C. Swanson, Toronto
Dr. Daniel G. Vaughan, San Jose, Cal.
Dr. M. S. Wolochow, Regina, Sask.

GUIDELINES FOR PUBLICATION

1) All articles intended for publication should be submitted to the editors before the deadline which is usually *six* weeks before the release of the Journal.
2) Submitted articles should be typed (or legibly printed) double-spaced; single-sided on paper 8½" x 11" (letter size) and they should not be more than 15 to 20 pages (3000 to 4000 words)
3) Illustrations, graphs, diagrams, figures and photographs should be put on a separate sheet and identified by Arabic numerals. A list of explanatory legends for all the figures and diagrams should be put on another sheet. Do not write on the back of photographs.
4) References should be checked with the original sources, designated by Arabic numerals in the text, numbered in order of appearance and put on a separate sheet. Each periodical reference should include in order: the author's name and initials, title of the article, Journal name, volume number, page number and year. (e.g., 1. ROSEN HJ: Lumbar invertebral disc surgery: review of 300 cases. *Can. Med Assoc J., 101: 317, 1969.)*
5) The editors reserve the right to make such editorial changes as are deemed necessary to ensure correctness of grammar and spelling, clarification of statements and conformity to Journal style.
6) Acceptance for publication is subject to the understanding that such material is submitted solely to the Journal, and will not be reprinted without the consent of both the editors and author.

Medical Society Lecture
Guest Editorial

Additional Challenges for Medical Students

Paul E. Lacy, M.D.

Mallinckrodt Professor and Chairman, Department of Pathology, Washington University Medical School, St. Louis, Missouri.

The traditional challenges for medical graduates are to initiate careers in patient care, medical research or a combination of these two. Today there are additional challenges. These challenges are more difficult to define and require some understanding of what has occurred in the field of medicine during the past century.

In the mid 1800's, Dr. Rudolf Virchow and Dr. Paul Langerhans, Sr. served on the city council of Berlin. At that time the sewage from the homes and the shops was dumped directly into the gutters of the street. The citizens complained about the horrible smell and since the smell was bad then obviously it must be detrimental to your health. The two physicians on the council were aware of the stench, but they were more concerned about the possible presence of unseen agents in the sewage which could affect the health of the citizens. In order to gain some information about the health hazards of sewage, they visited the cities of Paris and London, since these two cities had recently installed sewers. They reviewed the health records, in these cities and others, in order to determine the incidence of typhoid fever prior to and after the installation of sewers. They also examined the type of sewers that were installed and whether an open or a closed sewage system had any effect on the incidence of typhoid. From these studies, they were convinced that a sewer system must be installed in Berlin. Dr. Virchow worked with the city engineer; drew plans for a sewer system; decided that the sewage should not be dumped directly into the river but should be diverted to a sewage farm; established the location of the farm some distance from the city; required health examinations every six months for the workers on the sewage farm and calculated the cost of installing the sewers. The data, plans and cost of construction of a closed sewer system were presented to the council and this governing body quickly approved the plan and construction of the sewers.

During this same period of time, the individual physician had limited resources for either the diagnosis or the treatment of patients. They did have a close personal relationship with their patients in attempting to alleviate their suffering, ease their dying and, with some of their therapeutic measures, accelerate their rate of demise.

A revolution in science was also beginning during this era. The shackles of the mystic and humoral concepts of disease were being overthrown and replaced by a scientific foundation for understanding diseases in man. The Microbiological era of medicine was initiated and it was soon demonstrated that specific bacteria caused diseases in man and some of these organisms were present in sewage. In the ensuing years, basic science flourished and provided a tremendous fund of new information concerning the normal structure, function, macromolecular and molecular organization of the cells. A technological explosion occurred in science with the development of many new tools, techniques and sophisticated equipment to probe deeper into basic problems as well as to provide new methods for improved diagnosis and treatment of human diseases. As this era progressed specialization occurred and medicine gradually withdrew from the public resulting in the deification of the physician.

In addition, the cost of health care for the public increased due to the sophisticated laboratory tests and expensive equipment required for diagnosis and treatment as well as the need for modern hospital facilities for the care and management of the patient.

The image of medicine had changed, and the public, as well as the physician, was confused. The public began to visualize medicine as a cold science which was inhabited by white-coated individuals and the maintenance of this science required personal and financial sacrifices. Malpractice suits began to occur and the sympathy of the jurors was with the public since medicine appeared to be a science and in science mistakes cannot be made. The economic aspects of health care delivery attracted the attention of governments, and, through their actions, the physicians were separated even further from the public by making them civil servants.

In our cities, the citizens began to complain about the horrible smell of the air and since the smell was bad the polluted air must be detrimental to their health. This emotional response of the citizens was intensified by similar emotional statements from well-meaning scientists. The fundamental problem was a simple one. A new era was developing in medicine – the Microchemical era. The same emotionalism, confusion, fear and anxiety that had existed at the beginning of the Microbiological era were again present in this new era. What is needed are facts – solid, scientific facts. Does the polluted air actually cause disease in man? If this is correct then identify the specific microchemical factors causing disease and devise the means to eliminate specifically these elements. If they can not be eliminated then devise a means of eliminating the microchemical agents from the body or prevent them from

having an affect on the individual.

Challenging, difficult questions now face both medicine and the public. Some of these are as follows: How do you deliver excellent health care to all of the citizens of a country without destroying the economic stability of the country? How do you safeguard the health of the people from environmental hazards and yet not destroy the economical foundation of the country? How do you provide adequate nutrition to the entire population of all nations? How do you safeguard the lives of the people and and yet preserve their individual liberties and freedom? How do you develop safer means of transportation and have them accepted by our society? How do you conduct clinical trials on new therapeutic agents and avoid potential harm to the involved patient? Who is to define the criteria for life and death? What is the appropriate new source of energy in terms of potential health hazards and economic feasibility? These are some of the questions which are associated with the additional challenges facing medical graduates today.

The resolution of these questions and the formulation of decisions must have the direct involvement of the physician and the medical scientist in the future. This involvement can only come if additional training and expertise is gained by the medical graduate in the social sciences, such as sociology, economics, political sciences, urban planning, law, etc. Since the era of the mid 1800's, the social sciences have also advanced similar to the advances in medicine. In the mid 1800's, the educated physician could be expected to have a working knowledge of the social sciences and participate directly in resolving social problems.

The additional challenges to the medical graduates of today are not to re-establish the deified image of medicine but to obtain the necessary additional training so that medicine can once again participate equally and directly in the formulation of policies which will affect the health of our people. I hope that some of the medical graduates will take this unchartered path, turn their concern from a one-to-one relationship with a patient to a concern for the health of masses of people and obtain the necessary education and training in order to have an effective role in resolving these additional challenges.

Prognostic Indicators in the Treatment of Ankle Fractures*

J.D. Gollish, 7T8, B.A.Sc.

*R. I. Harris Award Winner

INTRODUCTION

The study of human joint function has historically evolved along two separate paths. One path is that of the assessment of clinical practice, the study of the whole, the realm of the romantic thinker. The other is that of biomechanics, the study of the parts which function as the whole, the realm of the classic thinker. Yet, as Pirsig describes, these two paths do not represent dichotomy of thought processes.[1] What they do represent are two different approaches to, and two directions of departure from, the same reality.

Over the past few years the author has been involved in numerous research projects which have pursued their goals along one path or the other in an attempt to describe more fully the function of the normal ankle joint, and its response to trauma. The discussion which follows grew out of a desire to try to correlate the classic and romantic thought lines in order to elucidate some of the "reality" of ankle joint function.

EXPERIMENTAL METHOD

Two separate groups of patients supplied the material for the analysis which follows. One group consisted of 25 patients whose ankles were considered to be normal. This group was selected from the records of the Fracture Clinic at Sunnybrook Medical Centre and was composed of patients who had presented at the Emergency Department with minor complaints and who, following complete examination, including both clinical and radiological assessment, were deemed to have normal ankle structure and function.

The other group consisted of 80 patients who had suffered ankle fractures two years or more prior to assessment. This group was part of a larger group of 125 patients who were involved in a clinical follow-up study of the long-term results of ankle fractures, in which the author participated. Due to the multi-hospital nature of the larger study and the differences in records available, 45 patients were excluded from the present analysis as sufficient data was not available.

The assessment of each patient consisted of two components, a subjective analysis and an objective analysis. The aim of the subjective analysis was to classify each patient, through clinical evaluation of ankle function, into one of three groups-good, fair or poor. The criteria for

article by Dr. M. Tile, concerning the larger study commented on above.[2] By definition, the ankle function of all patients in the control group fell into the 'good' category.

The objective assessment consisted of a series of measurements taken from standard X-ray of each ankle. These were used to calculate the two parameters to be analyzed, called talar tilt (TT) and mortice width (MW), (fig. 1). The X-ray projection needed in order to make the required measurements was a 15° internal oblique view of the ankle. The X-rays used in consideration of the normal group were those taken at the time of their evaluation in the Emergency Department. For the fracture group, the X-rays used were those taken four to six months following the original injury, at a time when the fracture fragments could be considered to be completely fused, and the mortice structure stable.

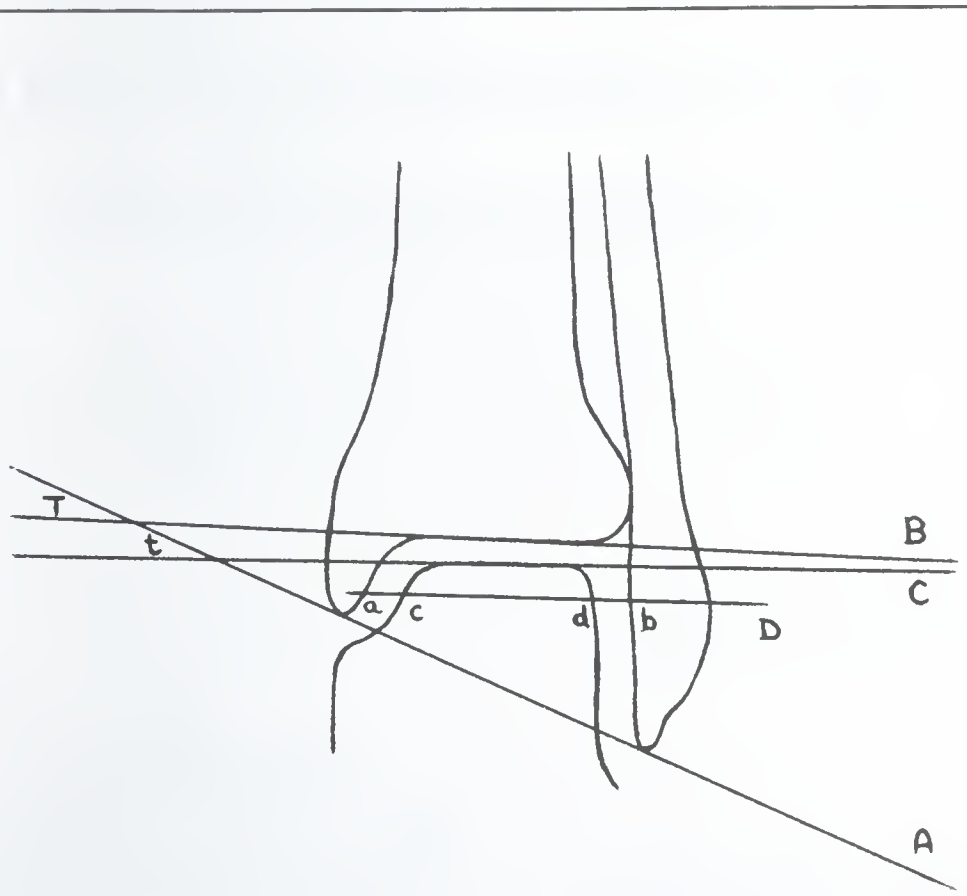


Figure 1.: *Method of measurement of talar tilt* (TT) *and mortice width* (MW) *from a 15° internal oblique X-ray of the ankle joint.* Line A: *Through the interior tips of the medial malleolus and lateral malleolus.* Line B: *Along the distal tibial surface which articulates with the dome of the talus.* Line C: *Along the dome of the talus.* Line D: *Parallel to and 5.0 mm distal to line C.* TT = *angle (T) – angle (t) in degrees.* MW = *length (ab) – length (cd) in mm.*

Having collected the necessary data, a statistical analysis was carried out on each group separately, followed by a comparison of the results of the fracture group to those from the normal, control group. The value of the two parameters as prognastic indicators was evaluated as the final step. All tests of statistical significance were carried out based on a 95% confidence interval.

RESULTS & DISCUSSION

Analysis of the measurements made on the X-rays of the two groups of patients is illustrated in figure 2. Certain points demonstrated by the statistical analysis deserve comment. The first is that, in the normal ankle, the talar tilt can be considered to be 0.0° , which implies that the dome of the talus and the articulating surface of the tibia are normally parallel structures. Those fracture cases whose eventual outcome was a good result also had a talar tilt which fell statistically within the range of parallel. However, those fracture cases with a fair/poor result fell outside the normal range. Thus, the normal group, and the 'good' fracture group can be considered to be statistically dependent, whereas the 'fair/poor' fracture group must be viewed as independent of both of the other two groups. With these statistical inferences in mind and taking into account measuring error and variations in X-ray technique, it was decided to choose, as an acceptable range of normal talar tilt, -1.50° to +1.50°.

Consideration of the analysis of mortice width reveals a slightly different picture. In the case of the normal group, the normal MW can be considered to be 4.00 mm. However, in comparing the means of the two groups of fracture patients to the normal group, and to each other, it was found that all three groups are independent, with the 'good' fracture group lying close to, but statistically independent of the normal group. In view of these facts the range for normal mortice width was chosed to be quite large, namely 2.0 to 6.0 mm.

Having arrived at a range of normal values for the parameters, talar tilt and mortice width, their value as prognostic indicators could then be evaluated. The result of this analysis is recorded in Figure 3. Once again, certain relationships are important. Figure 3(a) illustrates the statistical dependence of a 'good' result on the presence of a normal talar tilt, while Figure 3(b) demonstrates the dependence of a 'good' result on a normal mortice width. If these two factors are considered together, as shown in Figure 3(c), the appropriate statistic, namely the chi square test, indicates strong statistical dependence of a 'good' result on the absence of both an abnormal talar tilt and mortice width. In fact, of the 36 cases which had no measurable abnormality, 35 had a 'good' result, with only 1 achieving a 'fair/poor' outcome.

At this point in the discussion the discerning reader, no longer amused by statistical double-talk and the intricacies of the experimental technique, may possibly wonder what this all means in terms of management of ankle fractures. The implications of the analysis can best be summarized as follows:

1. If the treatment of the fracture has restored the talar tilt alone to within the normal range. the patient has approximately a 90% chance of having good ankle function.
2. Similarily, the restoration of the mortice width alone to within he normal range gives the patient a 75% chance of return to good function.

3. Finally, and possibly most important, if the result of treatment has been to restore both the talar tilt and the mortice width to the normal range, the patient can be virtually assured of having a normally functioning ankle.

SUMMARY

Studies of the biomechanics of ankle joint function have indicated that, at least in the experimental model, derangement of normal joint architecture leads to abnormal contact between joint surfaces with a resultant change in normal loading patterns.[3,4] These abnormal loads in turn have been implicated as a causative factor in the production of early degenerative joint disease.[5,6] From a clinical viewpoint, numerous follow-up studies of the long-term results of treatment of ankle fractures have been reported. These studies have shown that the success rate of treatment, that is treatment which produces a 'good' result, lies in the range of 70-80% , virtually indepenent of the fracture type or mode of treatment. Whether this 20-30% failure rate can be explained on purely biomechanical grounds, or whether the failures are due to other etiological agents remains unknown, and is the subject of considerable investigation at the present time.

The results of the study at hand, when considered in the light of the present body of knowledge, seem to suggest certain conclusions. The first is that restoration of the normal structure of the ankle mortice is the optimal treatment that one can offer in management of the patient with an ankle fracture. The second is that measurement of the talar tilt and mortice width, as described above, seems to offer a reliable means of assessing the normality of the ankle joint under consideration, and thus can be useful as prognostic indication of the results of treatment.

Finally, consideration must be given to the 'reality' of ankle joint function. Whether one approaches this point along the classic, biomechanical path in terms of lines and numbers and statistics, or along the romantic, clinical route, one must not lose the perspective that the 'reality' of the ankle joint lies within the reality of the patient and the quality of life which treatment provides.

	NORMALS		FRACTURE CASES			
			GOOD		FAIR/POOR	
	TT	MW	TT	MW	TT	MW
$\bar{x}$	−0.22	4.04	−0.54	4.67	−1.65	5.32
s	0.63	0.68	1.24	0.97	1.70	1.13
N	25.00	25.00	57.00	55.00	23.00	22.00
95%	−0.48 to +0.04	3.76 to 4.32	−0.87 to −0.21	4.41 to 4.93	−2.38 to −0.92	4.82 to 5.82

Figure 2.: *Statistical evaluation of the study groups.* x = *mean value* s = *standard deviation* N = *number in the sample* TT *less than 0.0° represents a varus tilt.*

	Normal TT	Abnormal TT
G	42	15
F/P	5	18

$X^2 = 16.17$

(a)

	Normal MW	Abnormal MW
G	46	9
F/P	13	9

$X^2 = 4.00$

(b)

	Normal MW+TT	Abnormal TT/MW
G	35	20
F/P	1	21

$X^2 = 19.73$

(c)

Figure 3.: *Enumeration of cases according to follow-up result and X-ray measurements. Estimation of the degree of statistical dependence by calculation of the chi square value* (x^2).

ACKNOWLEDGEMENTS

I would like to express my gratitude to Dr. M. Tile, Chief of Orthopaedic Surgery, Sunnybrook Medical Centre, for his invaluable guidance and continued support in this research venture.

REFERENCES

1. *Pirsig, R.M.: Zen and the Art of Motorcycle Maintenance. William Morrow and Co. Ltd., NY, NY, 1974.*
2. *Tile, Dr. M.: Personal Communication.*
3. *Sammarco, G.J.: Biomechanics of the Ankle. A kinematic study. Orthop. Clinics of N.A. 4: 75-96, 1973.*
4. *Riede, U.N.: Studies of the joint mechanics elucidating the pathogenesis of post-traumatic arthrosis of the ankle joint in man. II. Influence of the talar shape on the biomechanics of the ankle joint. Langenbecks Arch. Chir. 330: 174-184, 1971.*
5. *Gritzka, T.L.: Deterioration of articilar cartilage caused by continuous compression in a moving rabbit joint. JBJS 55A: 1968-1721, 1973.*
6. *Radin, E.L.: Response of joints to impact loading. I. In vitro wear. Arthritis and Rheumatism 14: 356-362, 1971.*
7. *Brodie, I.: The treatment of unstable ankle fractures. JBJS 56B: 256-262, 1974.*
8. *Burwell, H.N.: The treatment of displaced fractures at the ankle by rigid internal fixation and early joint movement. JBJS 47B: 634-660, 1965.*
9. *Klossner, O.: Late results of operative and non-operative treatment of severe ankle fractures. Acta Chir. Scand. Sup 293, 1962.*

Fred Gitz wasn't feeling well and went to the doctor for a check-up. After looking him over, the doctor prescribed rest and gave him a suppository with directions to come in again in about a week's time. A week later, Fred came back. "How are you feeling?" the doctor asked. "Terrible", replied Fred. Quite surprised, the doctor queried, "Didn't you take the suppository I gave you?" "Doctor," Fred answered, "for all the good that suppository gave me, I could have shoved it up my ass!"

Frequency of some Abnormalities in the Lumbosacral Spine Evaluated by Pre-Employment Roentgenograms

R. Anderson, 7T7 (PHE)

W.M. Brown, Ph.D.

SUMMARY

Pre-employment X-rays of the lumbosacral spine form part of routine examination to screen applicants where this region of the body will be subject to strain. In this study diagnoses from radiographs of 1,384 healthy young men applying to a large Canadian Mining and Smelting Company were tabulated and compared with results of other similar studies. In our report A-B-C categories separated applicants into good (42.4%), fair (33.3%) and poor (24.3%) risks for jobs entailing heavy labour. Normal X-ray findings (category A_1) were present in 22% of the applicants, 78% showed one or more defect in the lumbosacral area. Scoliosis (27.7%), Schmorl's Nodes (13.4%) and spina bifida occulta (13.2%) comprised the three most common abnormalities. Tabulation of the frequency of defects seen in additional X-rays from this radiographic pre-employment study will be the basis of future work.

STUDY

Low back pain has caused more "lost man hours" in industry than any other single condition.[1] Thus, along with physical examination, lumbosacral abnormalities in 1,384 men as shown by the roentgenogram. These men, whose age averaged about 24 years, were physically normal and had applied for employment between 1967 and 1971. X-ray evaluations were made by four radiologists, Dr. D. J. Heslin and his associates.

Our results stating the frequency of certain common abnormalities found in this region of the vertebral column are presented as well as the findings of six other similar studies. We found that 78% of the men examined showed some abnormality in the lumbosacral region. Although the classifications of abnormalities were not identical from one study to another, comparisons concerning certain defects could be made between our study and others. The frequencies of some of the tabulated abnormalities stated in other reports were in agreement with ours.

MATERIALS & METHODS

Roentgenograms of the lumbosacral region of 1,384 men between the ages of 18 and 67 (Figure 1) were made available to the Department of Anatomy at the University of Toronto. These X-rays had been taken by Dr. D. J. Heslin, in his clinic, Diagray Limited, Toronto, to aid in screening applicants for employment.

All subjects were classed as normal on physical examination. For each individual an average of four standard X-rays were taken; the anterior--posterior (A-P) and lateral views were taken in the standing position (without shoes), obliques (at 45°, P-A) in prone lying. Additional X-rays were taken when it was deemed necessary to confirm a diagnosis. The majority (90%) of the films were read by Dr. D. J. Heslin, others by Drs. E. Wong, H.M. Patel and R. McCallum. A detailed written report was made on each case.

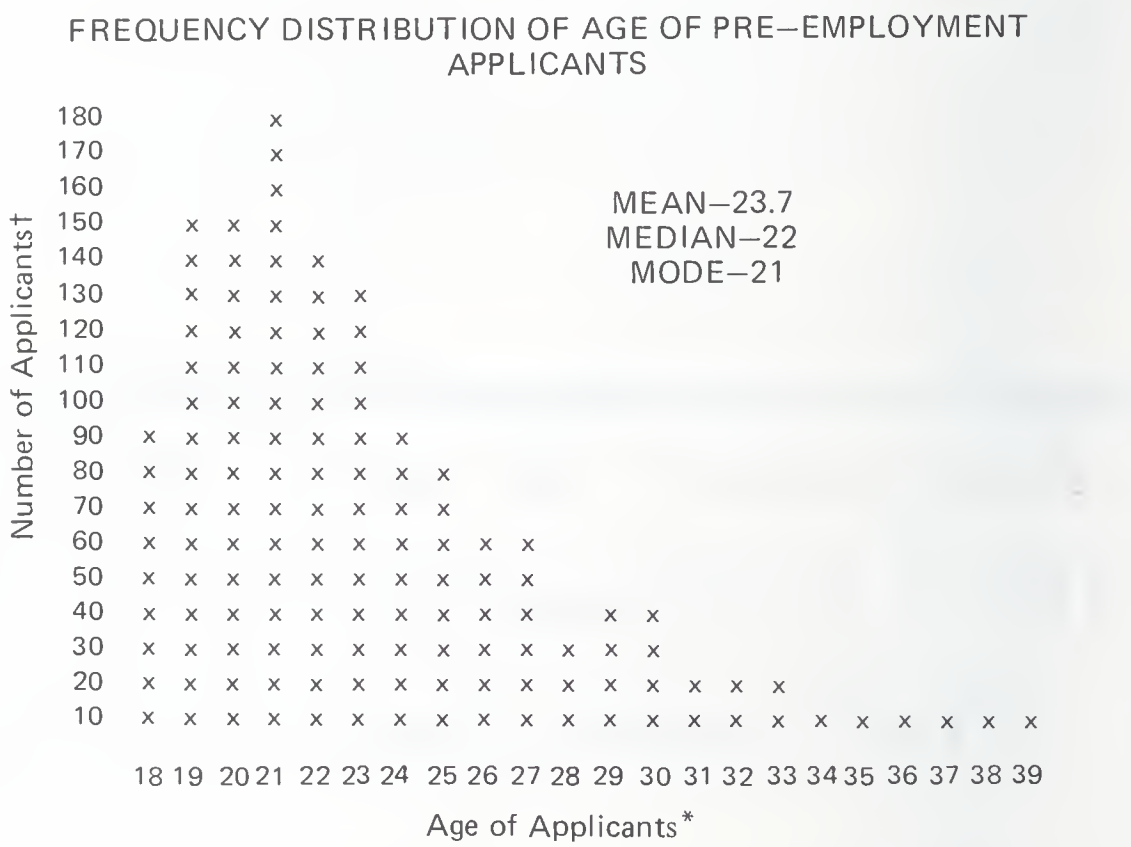
A,B and C categories established three main groups relative to the X-ray findings in the lumboscral area. Further subclassifications (Table 1) were made for specific pathology. This method to separate good, fair and poor risk applicants for heavy labour was adapted by Drs. Brent Hazelwood and D.J. Heslin from a similar pre-employment appraisal used at Dominion Foundaries and Steel, Ltd., Hamilton. In all there were 55 diagnoses of abnormalities within the A-B-C grading used in our study; of these we estimated the percentage frequency in the group of 1,384 men of the defects listed in Table 2.

RESULTS

The A-B-C categories and subclassifications (Table 1) which were used for this study of roentgenograms were appropriate to select individuals capable of high performance under conditions hazardous to lower back stability. Individuals in Group A were considered to be a good risk for heavy labour, those in B Group a fair risk and those in Group C were rejected for heavy labour. Some defects were listed in more than one category (A,B or C) depending upon the severity of the condition. Thus scoliosis, Schmorl's nodes, spina bifida occulta and degenerative disc disease did not necessarily exclude an applicant from employment, but rather the extent of the condition and/or a combination of defects determined an individual's classification with regard to suitability for employment. In comparable studies cited in Table 2 the A-B-C categories of classification were not used.

On the basis of the A-B-C category used in this study 42.4% (585) of the applicants were screened as a good risk for employment, and could do any job requiring physical strain; 33.3% (463) were a fair risk and not suitable for continued heavy low back work;

Figure 1



*One 45 and one 67 year old applicant are not represented in the table.

†The number of applicants in each age group was rounded off to the nearest multiple of ten.

TABLE 1

THE ROENTGENOLOGIC CRITERIA FOR APPRAISING THE HUMAN BACK

A. GOOD RISK (employable for any job requiring physical strain or effort)

1. Normal findings.
2. Atavistic changes.
3. Mild scoliosis without rotation.
4. Four or six lumbar vertebrae.
5. Ununited epiphysis of the pars articularis.
6. Mild asymmetry of the zygapophyseal facets.
7. Spina bifida occulta.
8. Schmorl's nodules in upper lumbar spine.
9. Transitional lumbosacral vertebrae with solid fusion of both transverse processes.
10. "Increased" lumbar lordosis.

B. FAIR RISK (defects present. For labor but not for continued heavy low back work)

1. Appreciable asymmetry of the zygapophyseal facets.
2. Moderate spina bifida occulta.
3. Schmorl's nodules at the L4 or L5 level.
4. Moderate degeneretive changes in the upper lumbar spine, or small vertebral body spurs in lower areas.
5. Moderate increase lumbar lordosis.
6. Mild scoliosis with mild rotation.

C. POOR RISK (defects of such a magnitude as to render heavy lifting or heavy labor inadvisable)

1. Narrowing intervertebral joint space.
2. Spondylolisthesis. 2.R. - Reverse spondylolisthesis.
3. Spondylolysis - prespondylolisthesis - pedicle defects.
4. Vertebral body spurs lower areas:
   (a) generalized osteoarthritis.
   (b) moderately advanced osteoarthritis.
   (c) advanced osteoarthritis of any type.
5. Lumbar kyphosis.
6. Marked increase in lumbar lordosis.
7. Decrease of lumbar lordosis (poker spine).
8. Acute lumbosacral angle - 45° or over.
9. Hip joint disease.
10. Schmorl nodules separating or deforming anterior or posterior margin (limbus vertebra).
11. Vertebral body deformities - old fractures or infections.
12. Scoliosis with rotation.
13. Marked deformities due to residual epiphysitis.
14. Operative defects:
   (a) laminectomy.
   (b) fusion.
   (c) discotomy.
   (d) radio-opaque material in neural canal.
15. Developmental:
   (a) hemivertebra.
   (b) wedged vertebra.
   (c) spina bifida - true.
   (d) Occulta at 2 or more levels.
   (e) marked variation apophyseal joints.
   (f) transitional vertebra.
16. Bone or joint lesions of destructive or formative type:
   (a) osteoporosis - disc bulging - biconcave bodies.
   (b) osteochondritis.
   (c) osteitis cystica.
   (d) spondylitis - ankylosing - Marie-Strumpell.
   (e) tumors - hemangioma.
   (f) fragility and weakness osseous structure.
   (g) infectious lesions of bones.
   (h) Paget's.
   (i) Ununited epiphysis with reaction or deformity.
17. Miscellaneous bone and soft tissue.

24.3% (336) were a poor risk for heavy labour.

The A_1 category comprised individuals who showed no abnormality of vertebral body, height, alignment or interspacing. These are classed as normal (Tables 1 and 2) and form 22% of our total number of subjects. All other individuals had one or more defects and were classified as abnormal (78%). We chose to tabulate some specific abnormalities which were most commonly encountered in the X-rays of this pre-employment population. Our results are shown in Table 2. Two defects that did present frequently and which yet remain to be assessed are mild asymmetry of facet joint articulation and the presence of coronal joints.

In Table 2 the summarized percentage frequencies of defects assessed show that 10.6% of 1,384 individuals had a transitional vertbra, 27.7% had scoliosis, 13.4% showed Schmorl's nodes, 2.4% had spondylolysthesis, 0.3% had reverse spondylolysthesis, 0.5% had spondylolysis, 13.2% had spina bifida occulta, 3.5% showed epiphysitis, osteoarthritis was present in 0.4%, spurring occurred in 6.4% and indication of degenerative disc disease was seen in 2.4% of individuals.

Although in four of the six comparable studies (Table2) normal diagnosis of the lumbosacral region was made in less than 50% of the pre-employment applicants, only in Stewart's[2] study does the percentage frequency of normal assessments (18.8%) approximate that of our study (22%). The presence of transitional vertebrae was reported in all studies and assessment of this defect showed a range of 4.7% to 10.6%. Defects showing considerable variation from one study to another were scoliosis (2.3% - 27.7%), Schmorl's nodes (0.95% to 13.4%), osteoarthritis (0.4% to 19.2%) and degenerative disc disease (2.4% to 14.1%). Relativley close agreement was found between studies in the conditions spondylolysthesis, spondylolysis and spina bifida occulta.

DISCUSSION

Loss of man hours and high compensation costs following back injury have prompted screening of applicants by a complete physical examination and X-ray evaluation prior to employment in jobs where there is a risk of damage to the lumbosacral spine. In this pre-employment study of 1,384 applicants, on tabulating their X-ray diagnoses made, we grouped them initially into two main classes, normal and abnormal, as shown by the radiographs of the lumbosacral spine. We found that the percentage of normal backs was surprisingly low (22%), especially when it is considered that each of these men had been assessed on medical examination as normal. This same trend is apparent in the majority of studies cited (Table 2). Too, La Rocca and Macnab,[8] in evaluating pre-employment radiographic assessment of the lumbar spine, state that no deviation of any description was encountered in only 7.3% of 150 men all of whom were asymptomatic for back pain. It would appear that the abnormal back is the common finding radiographically in such populations. It must be emphasized, however, that radiographic incidence of abnormality in the lumbosacral region has been shown to be compatible with a pain-free back and does not necessarily lead to back injury.[9,10]

From Table 2 it will be noted that the defects tabulated do not agree

TABLE 2

ANALYSIS OF X-RAY EXAMINATION OF THE LUMBOSACRAL SPINE

	PRESENT STUDY	DATA FROM COMPARABLE STUDIES					
	Anderson & Brown (1976)	Stewart[2] (1947)	Barton[3] (1948)	Colcher & Hursh[4] (1952)	Runge[5] (1954)	Coulter[6] (1956)	Reiner[7] (1958)
Number of individuals X-rayed	1384	1049	1064	1500	4654	227	1030
Average age (years)	23.7	30		25.3	35		25
CLASSIFICATION	%	%	%	%	%	%	%
Normal	22	18.8	40.6	55	68	34.3	40.7
Abnormal	78	71.2	59.4	45	32	65.7	59.3
TRANSITIONAL VERTEBRA	10.6	5.1	7.0	4.7	6.8	6.2	9.9
Incomplete fusion of T.P. to ilium (right)	6.5						
Incomplete fusion of T.P. to ilium (left)	9.1			60.6			
Incomplete fusion of T.P. to ilium (bilateral)	26.0			39.4	100%		
Complete fusion of T.P. to ilium (bilateral)	7.8						53.5
Hemisacralization of LV5 (left)	12.4				40.4		100%
Hemisacralization of LV5 (right)	3.2						
Sacralization	1.3				50.1	58.1	46.5
4 non-rib-bearing vertebrae	22.7				100%	100%	
6 non-rib-bearing vertebrae	11.0				9.5	41.9	
	100%						
SCOLIOSIS	27.7		14.5	13	2.3	6.6	5.1
SCHMORL'S NODES	13.4	1.0		13		6.1	2.4
REVERSE SPONDYLOLYSTHESIS	0.3					0.4	
SPONDYLOLYSTHESIS	2.4	3.8	1.7		2.1	6.2	0.8
SPONDYLOLYSIS	0.5	4.6	1.2	2.9			0.8
SPINA BIFIDA OCCULTA	13.2	19.0	24.6	20.0	3.1		20.9
First sacral segment	91.2		80.5				19.9
Fifth lumbar segment	5.5		9.5				
	100%		100%				
L5 & S1 & S2 or other	3.3		10.0				1.0
EPIPHYSITIS	3.5		0.8	0.9			
OSTEOARTHRITIS	0.4		9.4		19.2	3.6	
SPURRING	6.2			3.0			1.8
DEGENERATIVE DISC DISEASE	2.4	10.2			2.5	14.1	2.4

totally with the list of abnormalities in the A-B-C categories. Subclassifications of transitional vertebrae listed in Table 2 are those stated as abnormalities on diagnoses of X-rays of the 1,384 applicants. Some difficulty in evaluating the frequency of transitional vertebrae and its subheadings has thus been encountered due to this discrepancy. In our study, 146 individuals showed transitional vertebrae although a total of 154 abnormalities were enumerated radiographically. This may have resulted, for exmple, due to the fact that the incidence of incomplete fusion (unilaterally or bilaterally) in the 146 men was 41.6%; incomplete fusion was also diagnosed at times as hemisacralization (15.6%). Similarily diagnoses of sacralization and four non-rib-bearing vertebrae overlap with complete fusion of the transverse process. However, such redundancies occurred in only 5.5% of our cases showing transitional vertebrae, but caution should be observed in comparing our study with others for this vertebral defect as it was difficult to interpret how frequently such overlaps may have occurred in the comparative data cited. In the literature standardization of terminology for this abnormality is not apparent and one descriptive term seems to be synonymous with others.

In the present study, as in many others, radiographs of the total vertebral column were not taken. Therefore, in the instance of four or six non-rib-bearing vertebrae, it was not possible to assess with confidence whether a caudal or cephalic shift had occurred. Six non-rib-bearing vertebrae may represent lumbarization of the first sacral segment or of a twelfth thoracic segment. Since the number of sacral segments could not usually be counted radiographically in the standard X-rays taken, clarification of the exact number of lumbar vertebrae was often difficult to obtain.

The incidence of scoliosis was found to be relatively high in our study when compared with others. (Table 2). This may reflect the inclusion of minimal, mild and severe scoliosis in the present study, while Runge[5], who reported an incidence of 2.3%, may have only evaluated severe scoliosis.

It is of interest to note that spina bifida occulta occurs most frequently in the first sacral segment in all studies cited. Spina Bifida at all levels is one of the most frequent abnormalities tabulated in our data.

The presence of osteoarthritis in our applicants was low, especially when

(cont. next page)

Art in Medicine

Margo Siminovitch A.A.M. (Year II)

It might appear superficially that the artist and the doctor follow two dichotomous paths. Surface distinctions, however, should not obscure the fact that the paths often meet and continue together as one. Knowledge is frequently dependent upon drawings or diagrams in order to be communicated, and it is the medical illustrator who provides the essential link between medicine and art.

The doctor, like the artist, observes nature and then records his findings. The doctor, however, is limited to the written word which he sometimes finds is inadequate to fully transmit what he has learnt. It is not surprising therefore that most, if not all, courses taught in medical schools today rely on visual aids, not only as drawings in texts, but as videotapes, slides, films, models, etc. The medical illustrator therefore plays an important role as a teacher, presenting complex ideas in a graphic, comprehensible manner.

The training of medical artists within or under the aegis of the medical school is often questioned, but I feel it is essential. I stated above that the medical illustrator is a teacher of doctors and medical students, but the reverse holds true as well: the illustrator must be a student of the doctor. To be a translator, one must learn the language; likewise, to be a medical artist one must be conversant with medical terminology. In addition, to communicate what one does not understand is an impossible task. It is necessary for the artist to be exposed to as much medicine as is possible. All such knowledge is relevant and the beauty of the artist's efforts must be within the rigid framework of accuracy. It is these very strict limitations which are by definition laid down for the medical illustrator that in fact make this field so challenging and stimulating.

Diagrams, charts and statistical tables are classified as medical illustrations. These introduced the concept of quantitative thinking into medicine, and has a direct relationship with the history of thought; the development of modern medicine has been dependent on quantitative thinking. As Professor N. Joy, Director of the Department of Art as Applied to Medicine, University of Toronto, has written: *"Medical artists should be born teachers, artists by vocations, and scientists by nature."*

The field of medical illustration is by no means a modern specialty. Where it begins depends on the definition of the term. As it is regarded today, medical illustration is the graphic representation of any medical subject made for the purpose of communicating medical knowledge. In the historical sense, however, it includes all pictorial or sculptured representations which have connections with anatomy, bodily processes or disease. The point to be emphasized here is that in much of this medical art, the subject was chosen with no intent to teach medical facts, the medical character of these representations being incidental to the main picture or carving. Such art reflects, however, the concern that man has felt throughout the ages for his body and the disease and illnesses which afflict it.

It appears that the idea of scientific illustration originated in classical Greek thought. The two eminent anatomists of that time, Herophilus

compared with Runge's[5] figure. However, in the latter study 82.5% of the cases assessed were over 40 years of age. Our figures show only two individuals in this age bracket (0.1%). Runge reported no incidence of spurring and probably classed this abnormality with osteoarthritis. In our study 6.2% of the 1,384 men showed evidence of spurring.

Recently, additional radiographic studies have been made available to the University of Toronto. These will be reviewed and the diagnoses tabulated. The additional data obtained will augment the results of the present report.

ACKNOWLEDGEMENTS

We are grateful for the advice and assistance of Dr. D.J. Heslin, Radiologist, Grace Hospital, Toronto and Consulting Radiologist, Hospital for Sick Children, Toronto. We thank Mrs. Laurel Wheeler for kindly typing the manuscript.

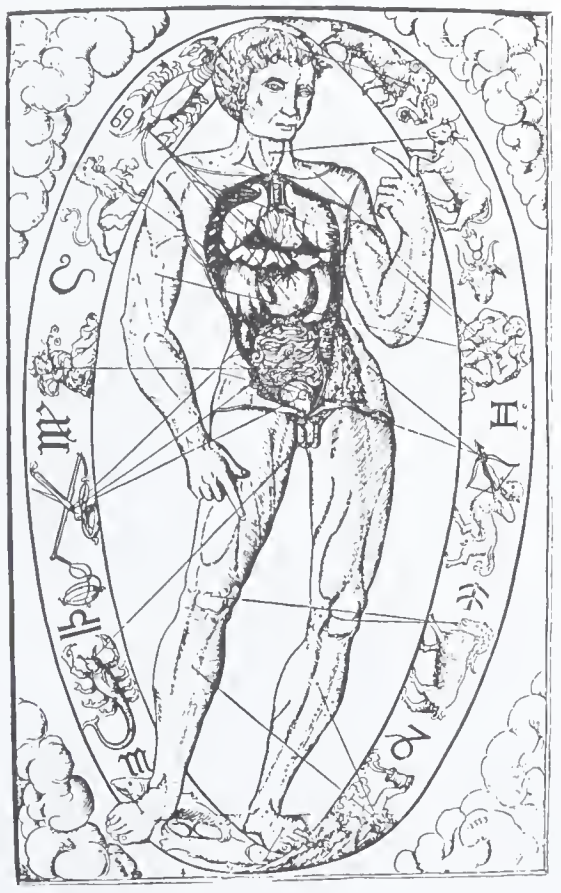
REFERENCES

1. *Moreton, R.D.: So Called Normal Backs. Indust. Med. and Surg., 38: 46-49, 1969.*
2. *Stewart, S.F.: Pre-Employment Examinations of the Back. J,Bone and Joint Surg., 29: 215-236, 1947.*
3. *Barton, P.N.: The Significance of Anatomical Defects of the Lower Spine. Indust. Med. and Surg., 17: 37-40, 1948.*
4. *Colcher, A.E. and Hursh, A.M.W.: Pre-Employment Low-Back X-Ray Survey. Indust. Med. and Surg., 21: 319-321,1952.*
5. *Runge, C.F.: Roentgenographic Examination of the Lumbosacral Spine in Routine Pre-Employment Examinations. J. Bone and Joint Surg., 36A: 75-84, 1954.*
6. *Coulter, E. B.: Prevention of Back Disability Through Pre-Employment X-Rays. Indust. Med. and Surg., 25:523-524, 1956.*
7. *Reiner, L.: Pre-Employment X-Ray Survey of the Lumbosacral Spine in Bus Drivers. Indust. Med. and Surg., 27:15-17, 1958.*
8. *La Rocca, H. and Macnab, I.: Value of Pre-Employment Radiographic Assessment of the Lumbar Spine. Canad. Med. Ass. J., 101-383: 49-54, 1969.*
9. *Brown J.R.: Manual Lifting and Related Problems. Labour Safety Council of Ontario, Ontario Ministry of Labour. 1972, pp. 473 and 483.*
10. *Gibson E. S. and Martin, R.H.: Dofasco Back Injury Prevention Program. 1972. (Dominion Foundaries and Steel, Ltd., Hamilton, Ontario).*

and Erasistratus, who taught in Alexandria, put the study of anatomy on a scientific basis and also used illustrations in their lectures. These drawings were employed to demonstrate what could not be shown on the subject by itself or to represent the subject in a few lines so that their students could easily remember the information.

The destruction of the Alexandria library by the Arabs in 640 A.D. caused all the above manuscripts to be lost, but there is evidence that certain pictorial representations used during the Middle Ages originated here. The best known of these is a series of characteristically related pictures named *The Five Figure Series.* They depict in a very schematic manner the bones, muscles, arteries, veins, and nerves. For centuries, they were the standard anatomical representations in Europe and other parts of the world. Travelers in part of China and Tibet have seen pictures seemingly derived from the traditional *Five Picture Series* in use there as late as 1900.

Late in the medieval period, the restrictions on human dissection, which had been imposed by the church, began to relax. Illustrations indicating direct observation of internal structures appear in manuscripts from the twelfth to the sixteenth centuries. At this time, another type of anatomical figure known as a zodiac bloodletting chart became popular in Europe. The human figure showing veins and sometimes viscera was shown surrounded by the zodiac signs. Guidelines indicated to the surgeon where to cut and also when he should do so, depending on planetery influence. Up to the Renaissance and probably for some time afterwards, pictures showing the veins of the body were more in demand that any other medical subject. This is not surprising considering that bloodletting was one of the most practical forms of treatment for human illness from the time of Hippocrates up to the last century.

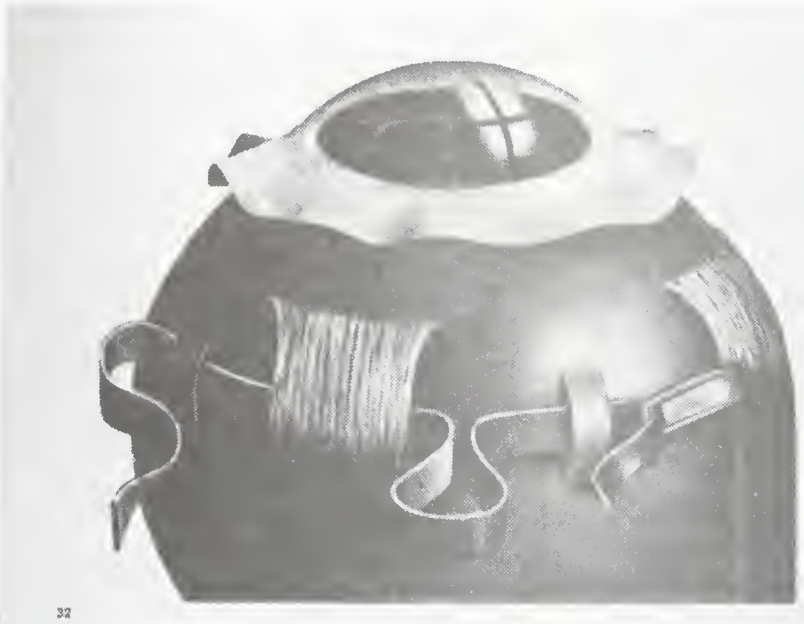


It was the Renaissance period, however, that saw the origins of modern medical illustration. Saunders, in his book on Vesalius, wrote this about the Renaissance: *"Art had gone scientific..., and it was therefore entirely logical that in their study of nature artists such as Verrochio, Mantegna, Signorelli, Pallaivolo, da Vinci, Durer, Michelangelo and Raphael, to mention but a few, should turn with enthusiasm to the efforts of those theorizing artists than to all the learned commentaries of the physicians on the Greeks and their Arabic interpreters."*

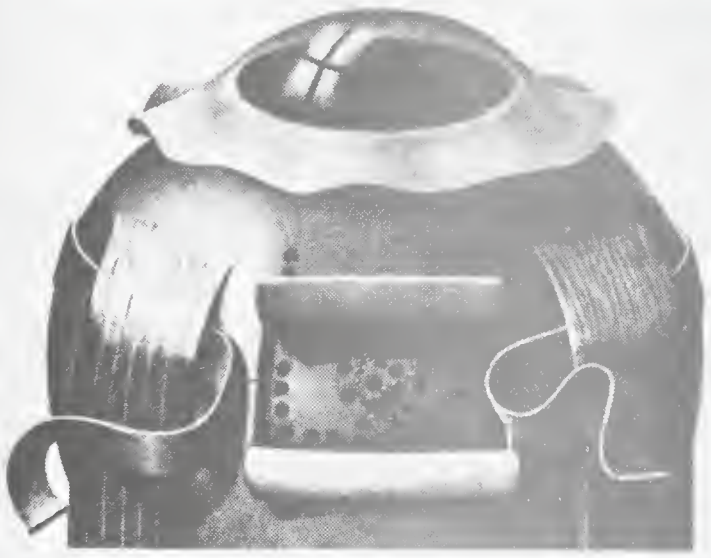
Most histories of modern human anatomy as well as of modern medical illustration begin with Leonardo da Vinci, who is known as the "Father of Medical Illustration". He was the first to explore systematically and to record pictorially the entire structure of man's body. It was da Vinci's plan to bring out a treatise on human anatomy, but his other interests prevented its completion. It is thought that if da Vinci had published what he had completed, it would have immediately revolutionized the sciences of anatomy and physiology.

Twenty-five years after the death of da Vinci, Vesalius published his now famous textbook of anatomy *De humani corporis fabrica.* Keeping in mind that it was even more noted for the superb quality of its illustrations. These remarkable woodcuts set a

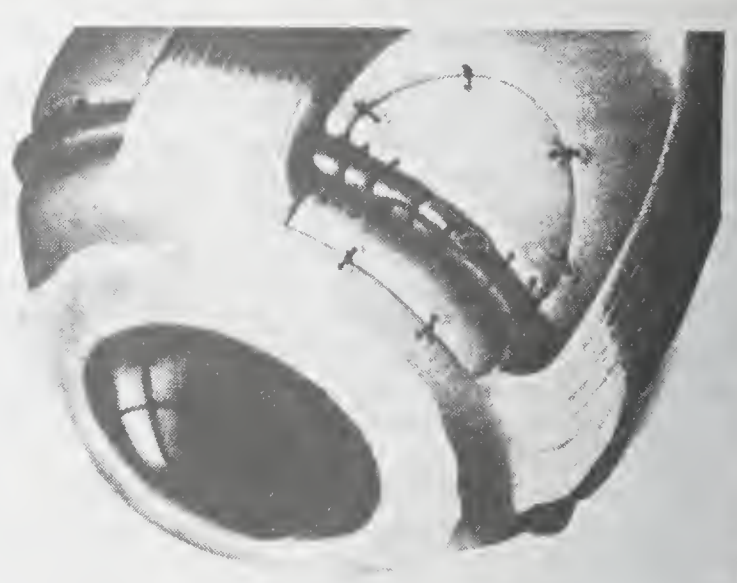
(cont. on page 110)



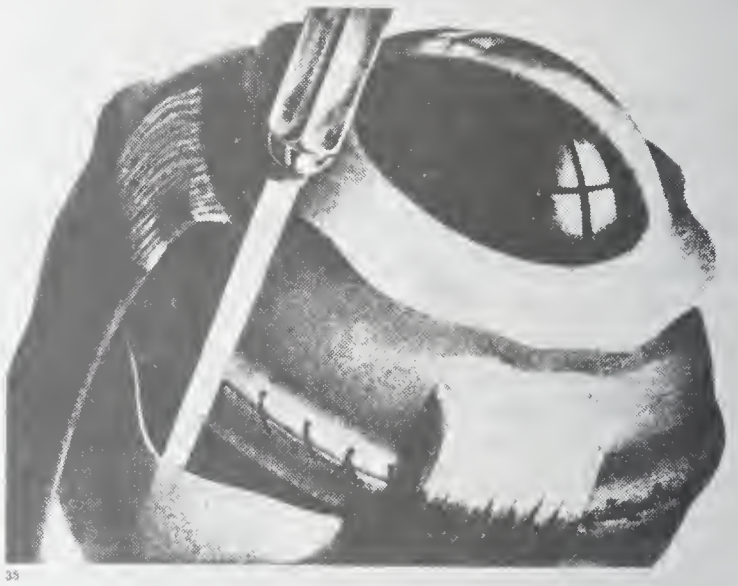
32



33

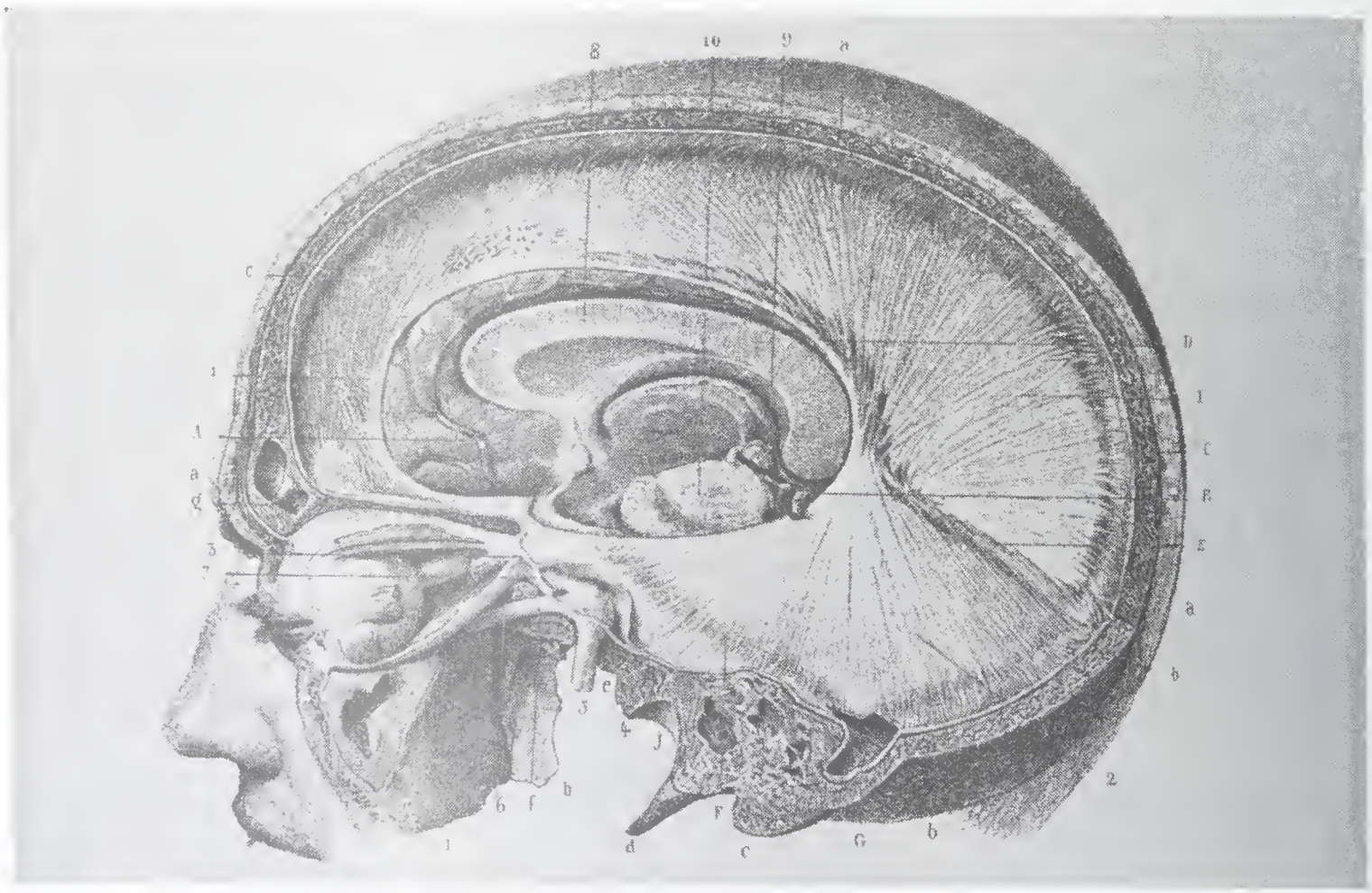


34

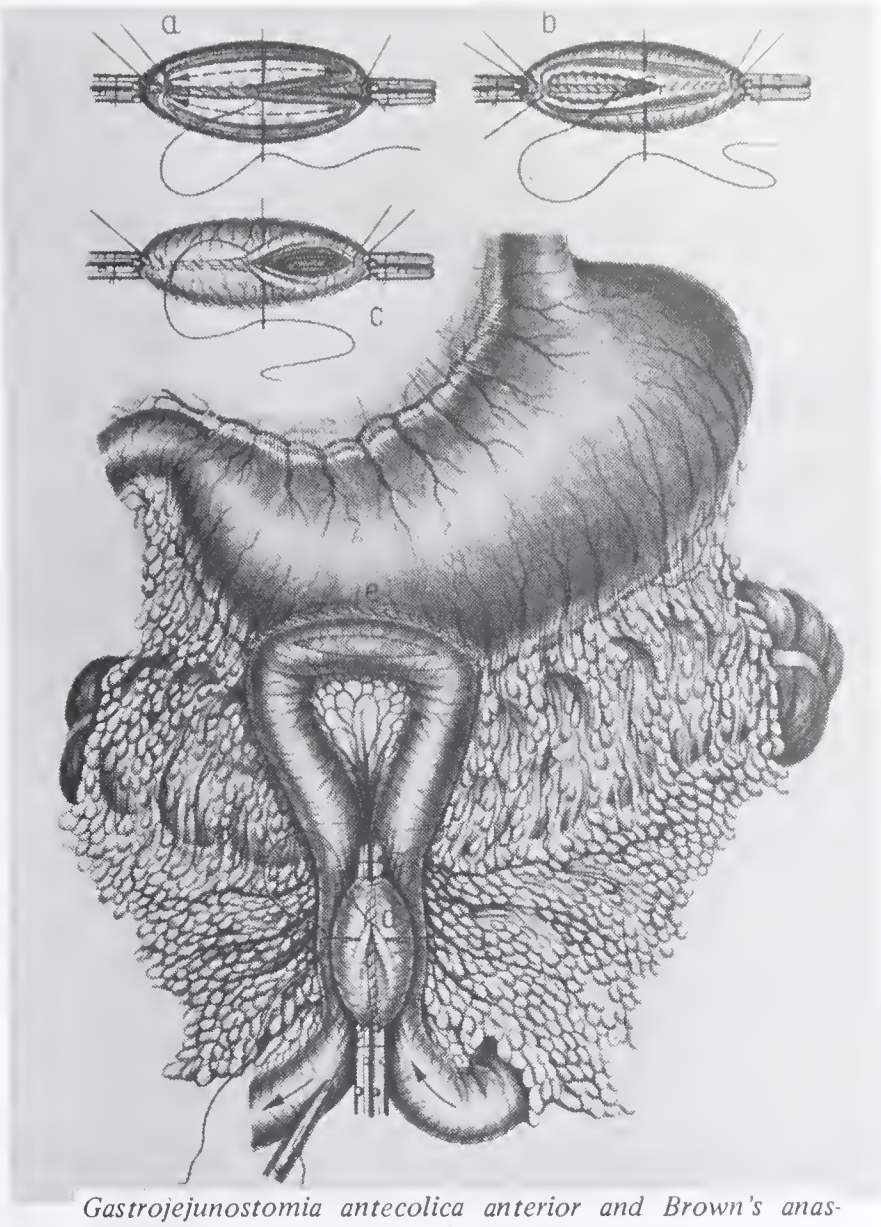


35

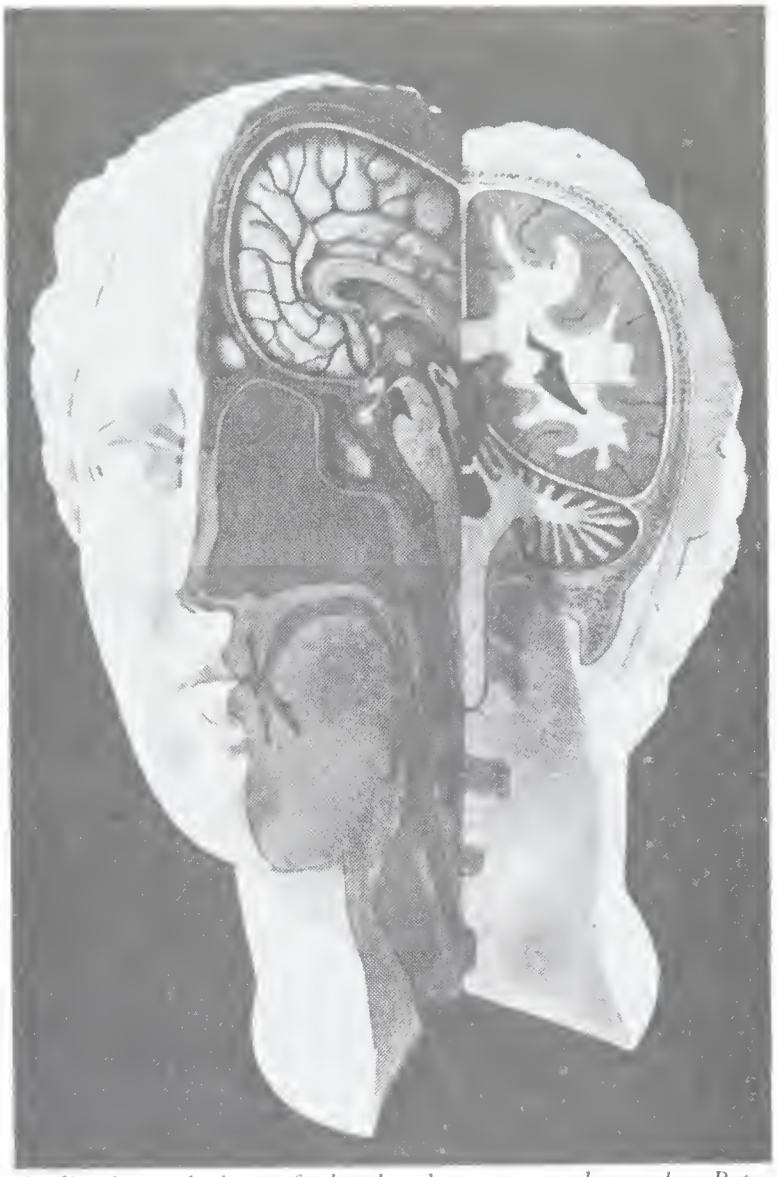
Ophthalmological illustrations by Willi Hess.



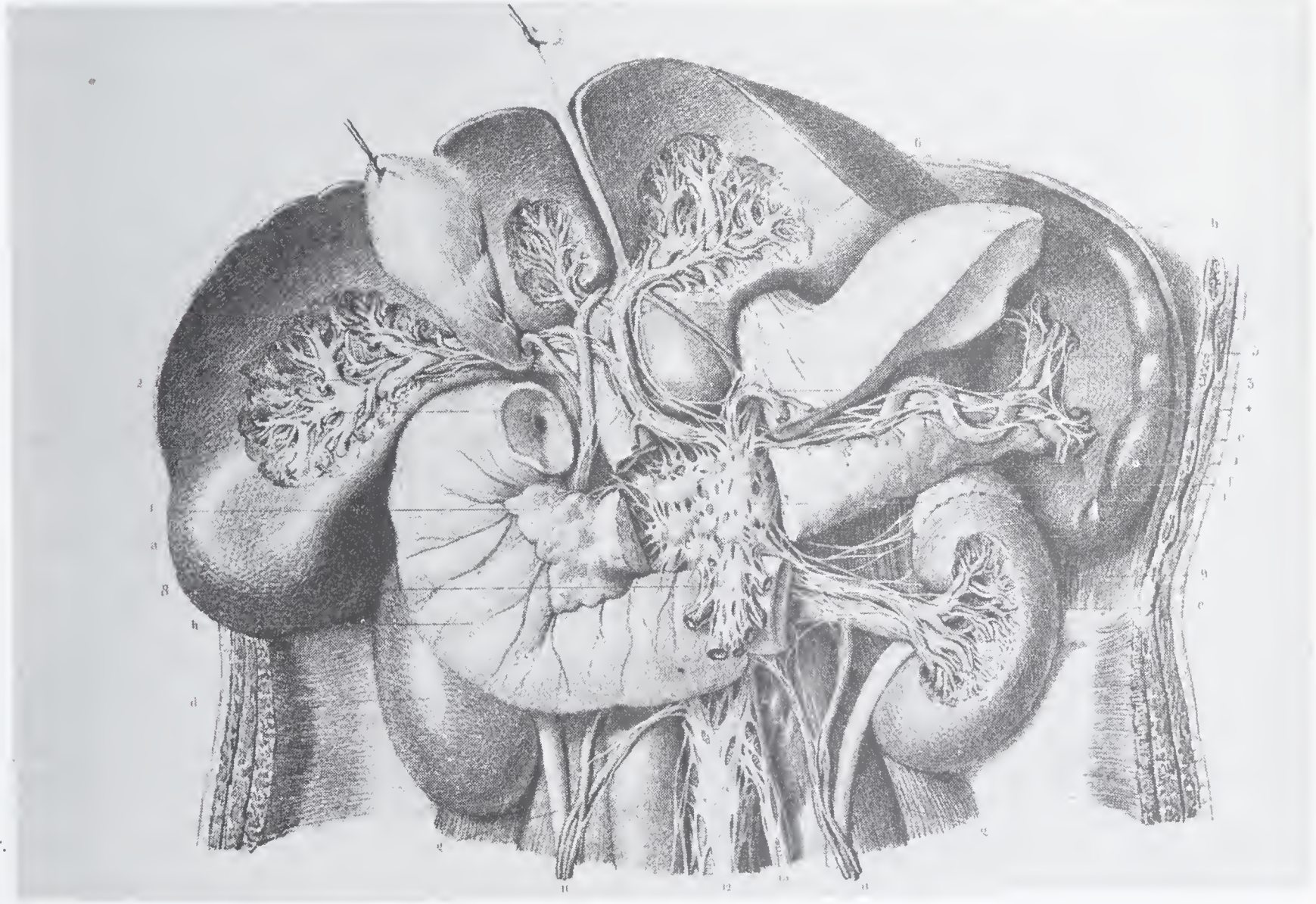
Drawings of J. Leveille's, a nineteen



Gastrojejunostomia antecolica anterior and Brown's anastomosis. Watercolour by Karl Schmid.



Stylized rendering of the head on two planes by Peter Schneider.

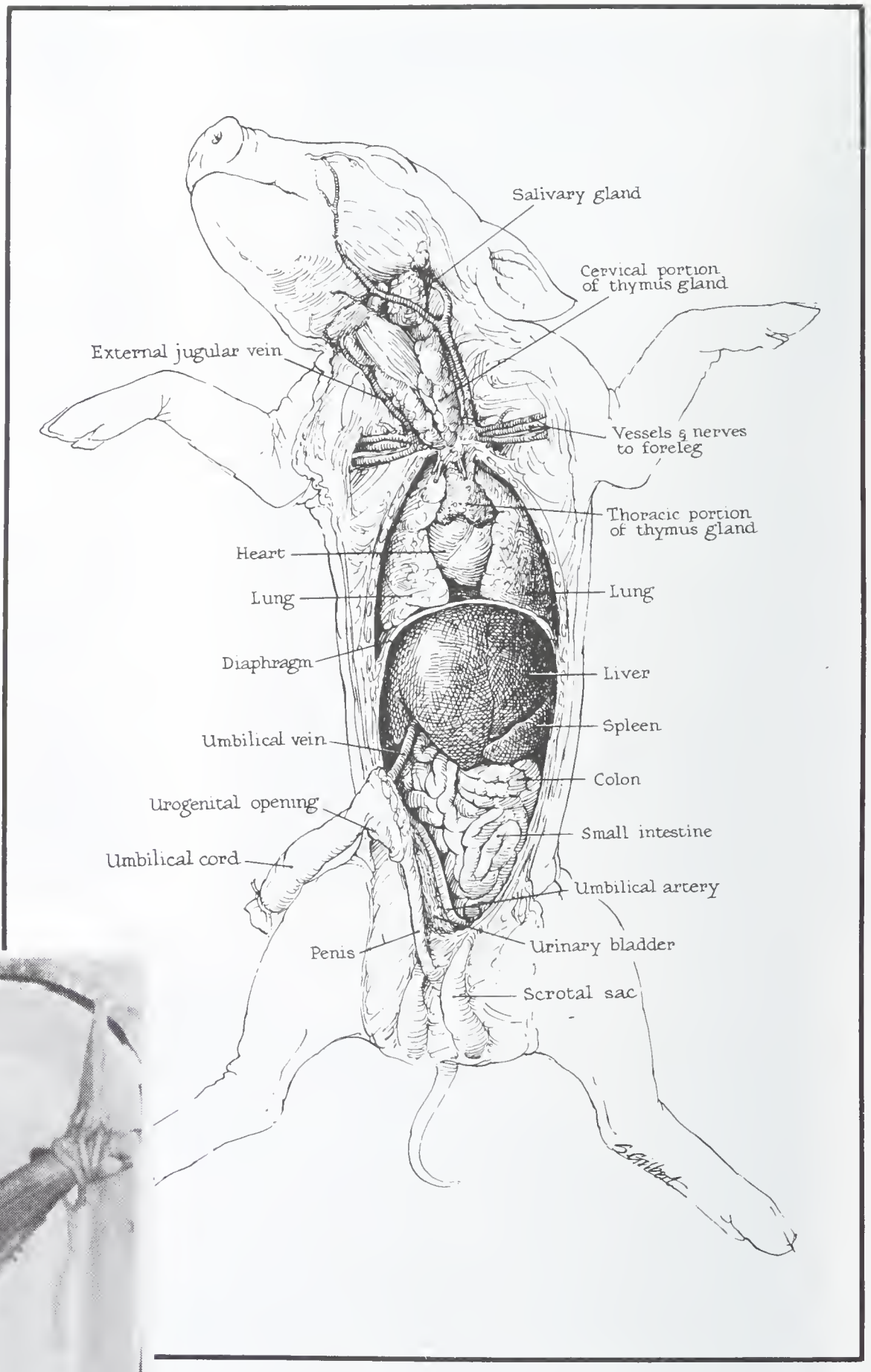


ıry illustrator.

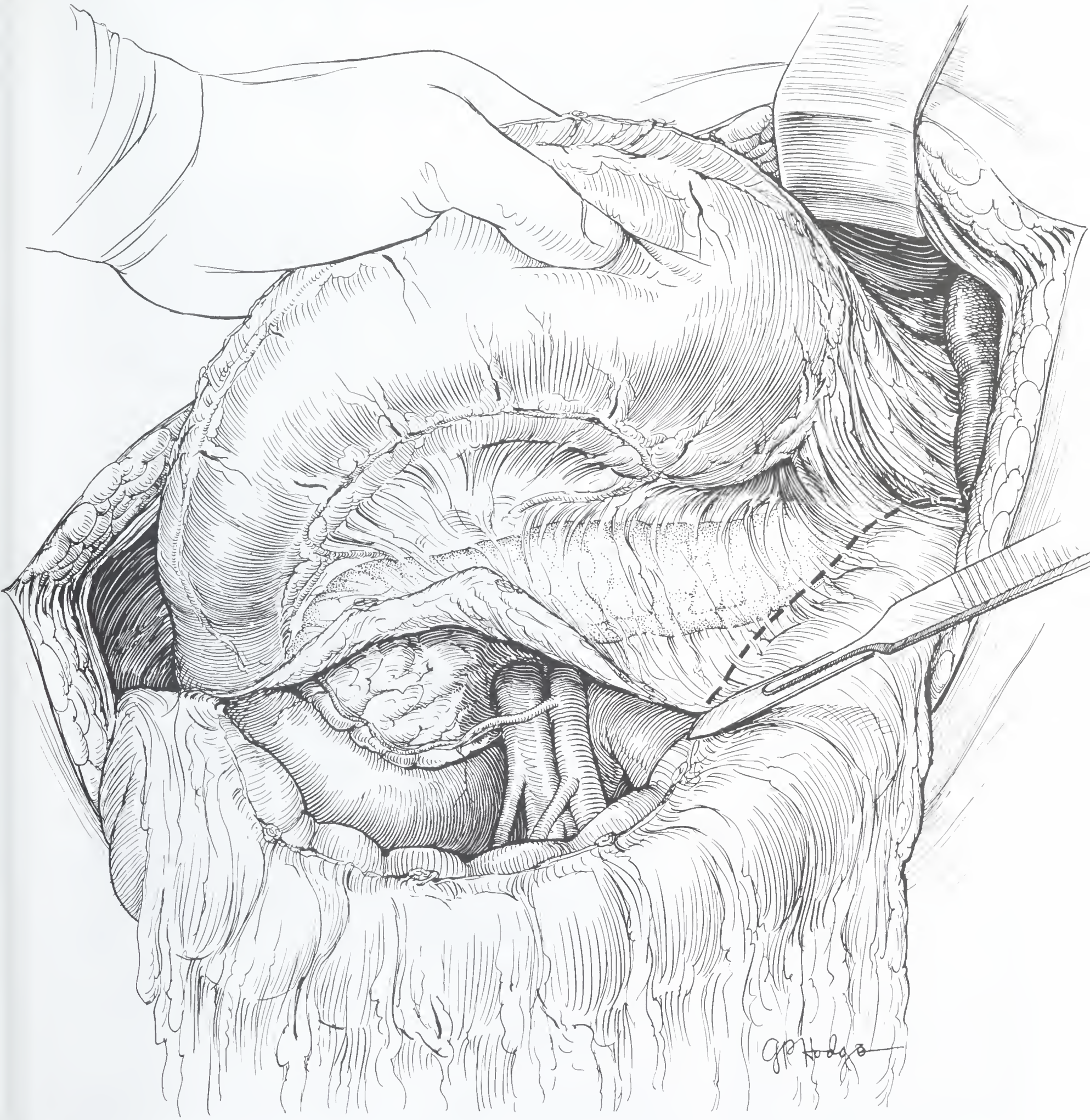
standard of excellence that lasted for years. From a contemporary viewpoint, the most interesting thing about the plates of the *Fabrica,* is the endowment of the figures with living attributes. They are posed like living figures and express feelings and emotions and the macabre result would, I am sure, amuse our 20th century surrealist artists. A good example is that of a young female sitting, coyly displaying the contents of her abdomen!

Soon after the publication of the *Fabrica,* wood engraving began to be replaced by work on steel and copper. The first medical picture on metal was made in 1545, when the artist da Carpi made some plates on copper for an anatomy by Battista. Though wood engraving continued to be used, the superiority of copper made it the material of choice, if fine detail and realism were required. Engraving and etching on copper were gradually replaced by mezzotint, lithography, and other techniques. Colour was infrequently used in anatomic illustrations until well into the nineteenth century, as it could only be reproduced by hand tinting over the black and white engraving.

(cont. on page 112)



Comparison of a photograph of a dissected fetal pig with an illustration drawn after a similar specimen, to show that the camera is unable to replace the illustrator. In this instance, artist Stephen Gilbert, Dept. of Art as Applied to Medicine, Univeristy of Toronto.



"Subtotal Pancreatectomy" for Charles Frey, M.D., Department of Surgery, University of Michigan. Publication: Surgical Techniques Illustrated, edited by Ronald A. Malt, M.D., Little, Brown and Co., 1977.

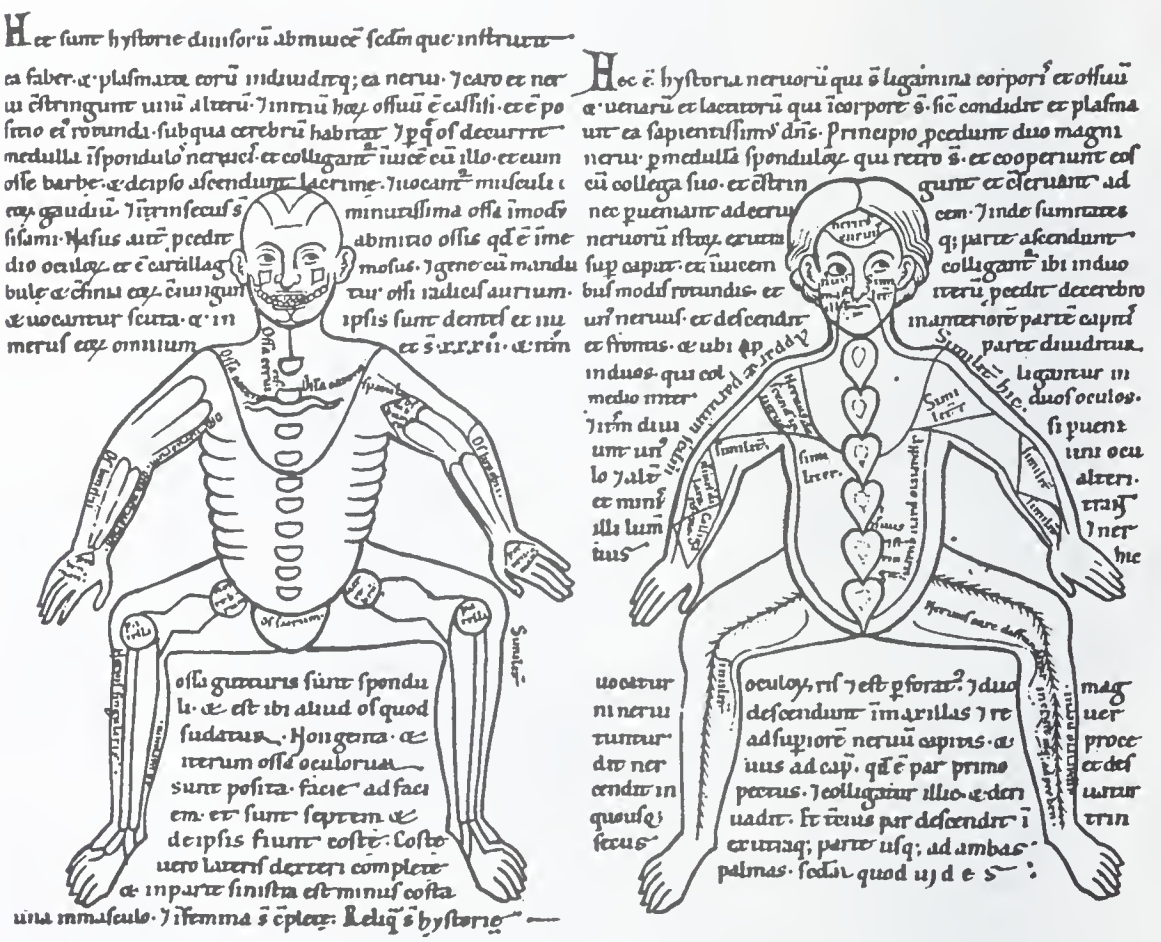
Matrices substantia incisa per medium, vt & eius fundum, & membranas inuersas facilius cernas. Collum item Veteris secundum rectitudinem diuisum, vt eius rugas & os vtrunque conspicias.

The development of photoengraving in about 1880 revolutionized medical education as well as all other fields of education. It provides an inexpensive and rapid method of reproducing and duplicating illustrations accurately. The technique of photoengraving steadily improved and resulted in an enormous increase in illustrated books and therefore a greater demand for artists.

The twentieth century has seen the greatest advances in medical illustration. As medicine has advanced, so has the need for graphic teaching materials. Certainly photography has made a tremendous impact on medical education. In addition to its ability to record quickly, it has made possible radical innovations in engraving and printing, and has allowed the development of the X-ray, film, television, etc. It is important to emphasize that these techniques are tools of the medical artist, and due to their inherent nature, cannot replace him. Despite the sophisticated advances in photography, the camera can only record what the eye sees. It is unable to differentiate and select what is important as opposed to what is trivial. It cannot simplify or clarify relationships nor can it conceptualize ideas of theories. For example, the arrangement of organs, vessels and nerves in the human body is so intricate and so often hidden by extraneous detail that a photograph tends to confuse rather than clarify. It is the medical artist still who must delineate surgical illustrations or drawings for the study of anatomy. In addition, the medical illustrator possesses the knowledge and ability to transform the appearance of a post-mortem specimen to its look during life.

Technological achievements in this century have contributed to a growing number of new sciences. This has resulted in a tremendous increase in the number of scientific and medical books published. The amount of illustration required to meet this demand and the demand made by the use of medical illustrations in advertising campaigns have created a need for artists with medical training. The first school of medical illustration was started in 1911 by Max Brodel, the most eminent medical artist of his time, at Johns Hopkins Medical School. This was the first of many such schools now existing including, of course, the Department of Art as Applied to Medicine, in the Faculty of Medicine, University of Toronto, under the directorship of Professor N. Joy.

The medical illustrator's role lies in his ability to construct from observation and knowledge a graphic representation which elucidates a medical concept or facilitates teaching. It is necessary for the artist to have a basic knowledge of the priciples of medicine so that he may employ his skills at their highest level and thus achieve the successful integration of art and medicine.



REFERENCES

The Artist in the Service of Science, ed. Walter Herdeg, The Graphic Press, Zurich.

The Evolution of Medical Illustration, Tom S. Jones, 1973; included in Essays in the History of Medicine, University of Illinois Press, Illinois.

History of Medical Illustration, by Robert Herrlinger, Editions Medicinal, 1965.

Medical Illustrator, by Nancy Joy, Occupational Information Monograph, University of Toronto, 1970.

Pulmonary Tantalum Angiography

Bruce Pollock, 7T9

Melvyn Goldberg, M.D., F.R.C.S.

INTRODUCTION

Regardless of its nature, size, or immunosuppressive treatment, transplanted tissue when rejected becomes necrotic. The vascular supply is lost when rejection is complete.[1]

Simmons et al., generalizing about transplantation rejection phenomena, suggest that:

It is impossible to determine what proportion of these effects result from ischemia produced by vascular occlusion, interstitial edema, or cellular infiltration. Similarly the contribution made by the direct cytotoxic action of specific and nonspecific effector cells and molecules is unknown.[2]

The prominent role and development of eschemia in renal allograft rejection has been intensively studied by morphologic,[3] and arteriographic[4,5] changes in blood flow, as measured directly by renal venous indicator dilution techniques and electromagnetic flowmeter.[6] Hollenberg suggests that allograft ischemia is produced not only by occlusion of blood vessels with cells, necrotic debri and thrombi or by vessel wall damage with arteriolar intimal thickening, arteriolar necrosis and disruption of capillaries, but also by vasomotor phenomena (at least in the early stage of rejection).[7]

The role of ischemia in pulmonary allograft rejection has been less intensively investigated. Flax and Barnes describe histologically the extensive vascular injury beginning early in pulmonary allograft rejection which they feel results in hemorrhagic necrosis.[8] Goldberg has found a progressive fall in perfusion of the transplanted lung with Technetium-99M labelled albumin microspheres.[9]

Pulmonary angiographic studies using methylglucamine diatrizoate (or 60% Renographin) demonstrate decreased perfusion by displaying increasing pulmonary transit times in the arterial phase and delays in venous filling times.[10] During chronic rejection this method may also indicate obliteration of the pulmonary tree but it fails to suggest the more detailed and intricate pathogenesis of the decrease in perfusion.[11]

The fact that vascular obstruction of the mocrocirculation is felt to play a prominent role in rejection would seem to make it desirable to determine pathological changes in the microvasculature and attempt to correlate these findings to other studies such as light and electron microscopy and ventilation perfusion scans. Specifically, we were interested in determining whether minute Tantalum particles could be utilized to produce high definition pulmonary arteriographs.

MATERIALS & METHODS

Tantalum is classified as a heavy transitional metal of the Vanadium group with an atomic number of 73 and a weight of 180.88. It is inert physiologically as well as chemically.[12] As a sheet mesh or plate it has been used successfully for long-term surgical implantation in man.[13,14] The inertness of Tantalum with regard to coagulation and platelet functioning was confirmed by Nagy.[15] As a radiographic agent Powdered Tantalum was first used by Nadel for bronchography.[16]

Dumont and his colleagues in New York discovered that Tantalum particles injected intravenouly still adhere to experimentally produced thrombi[17] and can be selectively deposited on injured vascular endothelia.[18] Nagy and Taylor at Toronto, in studying hyperacute renal xenograft rejection, compared the injection of Tantalum particles in the arteriolar bed with a standard replacement method of microfil.[19] They found the Tantalum method far superior in visualizing subtle changes of decreased glomerular perfusion, vividly displaying microvascular lesions. Microfil caused complete filling of the post glomerular bed and thus could not show segmental narrowing of the arterioles early in rejection.

Five grams of Tantalum powder of 1 micron size[20] were suspended in 10 millilitres of 9% dextrose and saline. Dumont has used 10% sorbitol and saline solution but we could not detect any improvement with this method. Better results were obtained with the rather high concentration of Tantalum suspension. A large flask seemed to facilitate suspension of the particles in a shallow draft. Long-term stirring with magnetic bars of various sizes was held to have no advantage over violently agitating the solution just prior to injection. Flushing the walls of the flask with a syringe and applying a Thermalyne mechanical agitator for a few moments just prior to infusion are useful. It is also important to insure that there are no air bubbles in the syringe.

Preliminary experimentation was carried out on New Zealand white rabbits (average weight 2 kg), and subsequently in dogs (of approximately 12 kg weight).

A series of experiments were initiated infusing a suspension of Tantalum into the main trunk of the pulmonary artery of a living rabbit and then immediately clamping and ligating the hila on inflation and then removing the lungs and subjecting them to tissue radiography.

alveolar or venous phase, thus destroying arterial definition.

It was subsequently decided to kill the animal, remove the heart and lungs, inflate the lungs, ligate the pulmonary veins, and then to infuse Tantalum. Care was taken that the lungs were adequately and evenly hyperinflated prior to infusion. This was found to be most easily accomplished by blowing into a pipette with a small plastic tube fitted over its end. The bronchus could then be clamped

Figure 1. *Normal rabbit lung tissue infused with Tantalum.*

Intubation and surgical anaesthesia in the rabbit are somewhat problematical.[21] Eventually a system of premedication with intramuscular chlorpromazine, followed by intravenous Nembutal (Pentobarbitol Sodium)[22] was used with considerable success. Intubation was accomplished using a 3 millimetre endotrachial tube and a pediatric laryngoscope. Ventilation was performed by a Harvard 607 apparatus.

Various methods of infusing Tantalum into the main trunk of the pulmonary artery (P.A.) were attempted during this period, including needles, catheters, and cannulae of varying guages and diameters. However it seemed that no matter how quickly the hilar structures were clamped after infusion, Tantalum was able to enter into either an and ligated with O-Chromic.

Prior ligation of the pulmonary veins to ensure back-up of Tantalum in the arterial suppy was performed although this precaution might not have been necessary in the congested, rejecting lung or, indeed, with larger Tantalum particle sizes. It was hoped to initiate experiments last summer with 5 and 10 micron particle sizes in various ratios with the 1 micron size but shipping delays of over 2 months prevented this.

In the rabbits, an 18-guage Argyle medicut cannula was threaded into the main trunk of the PA and approximately 13 millilitres of Tantalum suspension were very slowly infused into both lungs.

Figure 2. *Rabbit infused with 0.6 mg. of adrenalin into the main trunk of the pulmonary artery 15 minutes prior to sacrificing and Tantalum infusion. Widespread arteriolar constriction and back-up of Tantalum is evident during this infusion procedure.*

In the dogs, approximately 30 millilitres per lung were infused via IV tubing into the PA. The procedure was terminated as soon as darkening of the peripheral lung tissue could be observed. A water manometer Y-limb infusion procedure was tried in an attemt to quantify the injection pressure on the dogs as well as to insure that the canine pulmonary systolic pressure of approximately 20 millimetres of mercury[23] (270 millimetres of water) was not grossly exceeded. Other than adding consistancy, this monitoring was held to have no advantage over slow, careful infusion.

Tissue radiography was performed with two Cronex high resolution industrial films, speeds 65 and 45, offering complementary degrees of resolution and penetration. Lung tissue was placed in direct contact with the film and exposed in the "Faxitron" unit. Exposures of 20 Kv for 1 minute for rabbit lung tissue and of 30 Kv for 1-2 minutes for dog were found to be adequate. Films were developed in the automatic processor for 7 minutes at 32° C.

RESULTS

On normal rabbits the above procedures were used successfully to reveal excellent delineation of the lung's arterial supply. (Fig. 1) The finer branches of the pulmonary artery could be traced upon microscopic examination (40 times) into what

Figure 3. *Normal canine lung tissue. Note arterial definition and absence of thrombi.*

appeared to be arterio-venous anastomoses and capillary beds to the initial portions of the veins. Haematoxylin and eosin sections of lungs injected in this manner showed the main trunks of the pulmonary veins engorged with blood, with no detectable Tantalum particles.

The fact that this technique can be diagnostic of an ischemic episode in the lung was demonstrated in several rabbits by infusing 0.6 milligrams of adrenalin hydrochloride into the main trunk of the pulmonary artery prior to Tantalum infusion (Fig. 2).

This technique of pulmonary vein ligation and ex-corporeal Tantalum infusion was applied to both normal and post-transplant canine lungs. Normal lung tissue was obtained either from the recipient's left, removed prior to transplant or, preferably (because there were greater vascular and bronchial cuffs to work with), the donor's right lung (Fig.3). Transplanted tissue was obtained at autopsy (after tissue sections had been taken it was necessary to ligate severed vessels: Fig. 4). Frequently this transplanted tissue showed massive areas of ischemia with multiple peripheral thrombi. However, in some cases where the donor animal had been pretreated with immuno-suppressants as well as the recipient, the arterial integrity, as revealed by Tantalum angiography, was remarkably intact. This correlated well with ventilation and perfusion scans. Thus this technique of Tantalum arteriography might prove a useful agent in monitoring the efficacy of regimes of experimental imuno-suppression.

ACKNOWLEDGEMENTS

The above student project was supported by the Department of Surgery, University of Toronto.

REFERENCES

1. *R.T. Smith, The Mechanism of Graft Rejection, Clinical Orthopaedics and Related Research, Vol. 87, No. 15 (September 1972).*
2. *R.L. Simmons, J.E. Foker, R.R. Lower, and J.S. Najarian, Transplantation, in Principles of Surgery, eds. S.I. Shwartz and R.G. Lillehei (2nd ed.; McGraw Hill, 1974), p. 371.*
3. *A.G. Diethelm, Obstruction of the Microcirculation in Rejecting Canine Renal Allografts, Journal of Surgical Research, Vol. 9, No. 413 (1970).*

(cont. on page 117)

POEMS WANTED

The National Society of Published Poets is compiling a book of poems. If you have written a poem and would like our society to consider it for publication, send your poem and a self-addressed, stamped envelope to:

NATIONAL SOCIETY OF PUBLISHED POETS, INC.

P.O. Box 1976
Riverview, Florida, U.S.A. 33569

Figure 4. *Transplanted dog lung rejected 7 days post-op. and prepared in the same manner as the previous X-ray. Shows clear delineation of major arterial vessels but does not show Tantalum extending into the finer vessels of the microcirculation. Tantalum appears backed up into the major vessels. Multiple peripheral thrombi are evident.*

Historical Perspective of Medicine -The Oath of Hippocrates

Joseph Chu, 7T8

"Only the man who is familiar with the art and science of the past is competetent to aid in its progress in the future" --Billroth[1]

Hippocrates (460-377 B.C.), honoured as the "Father of Medicine", was one of the first Greek Ionian philosophers to integrate the Laws of the Universe as applied to the human body. From the work of Pythagoras on numbers and Democritus' theory on atoms, Hippocrates derived a principle which states that the human body and its function are subject to definite laws, just as are all events in the universe. He further stated that disease is a natural process and symptoms are reactions and signs are manifestations of the body to disease. The chief function of the physician is to aid the body in recovering from illnesses. Thenceforth, the trend of medical thought was drastically changed from magical concepts and priestly dogmatism to logical rationalizations based on observation, experience and criticism.

Hippocrates' writings and his teachings, along with his practice of the healing Art, earned him a great reputation for the centuries to come. Moreover, he had also laid down the fundamental moral and ethical code of professional practice which is the essence of the Art. He wrote in one of his books *On Epidemics*, the practice of Medicine entails three basic components:

1. Disease – a study of the natural course and outcome of processes inflicting the human body.
2. Patient – the course of any disease is determined to a great extent by the patient's environment and his way of life. Discordant organs affect the whole body and the body is made up of different organs.
3. Physicians – he should be regarded as Nature's helper in releasing and reinforcing the body's innate power to recover from diseases. Hippocrates further emphasized that a good doctor should be a man of character who is learned but modest, humane and wise.

"Let him behave to all honourable men in a friendly and easy spirit... Let his disposition be that of a man of honour...Let him conduct himself with a spirit of serenity..."[2]

With these invaluable thoughts, Hippocrates laid down the cornerstone of modern medical education, professional practice and medical ethics. His teaching of human compassion, his logical thinking based on scientific observation and guided by experience, and his practice on the understanding of the patient as a whole are elegantly consecrated in the Oath of Hippocrates:

I swear by Apollo, the physician, and Aesculapius, and Hygeia, and Panacea, and all the gods and goddesses that, according to my ability and judgement, I will keep this oath and this stipulation: to reckon him who taught me this Art equally dear to me as my parents, to share my substance with him and to relieve his necessities if required; to regard his offspring as on the same footing with my own brothers and to teach them this Art, if they shall wish to learn it, without fee or stipulation. By precept, lecture and every other mode of instruction, I will impart a knowledge of the Art to my own sons and to those of my teachers, and to disciples bound by a stipulation and oath according to the law of medicine, but to none others.

I will follow that system of treatment which, according to my ability and judgement, I consider for the benefit of my patients and abstain from whatever is deleterious and mischievous. I will give no poison to anyone, if asked, nor suggest any such counsel and, in like manner, I will not give to a woman a pessary to cause abortion.

With purity and with holiness I will pass my life and practice my Art. I will not cut a person who is suffering with a stone, but will leave this to be done by men who are craftsmen in this work.

Into whatever houses I enter, I will go into them for the benefit of the sick and will abstain from every voluntary act of mischief and corruption and, further, from the seduction of females or males, bond or free.

Whatever, in connection with my professional pracice or not in connection with it, I may see or hear in the lives of men which ought not to be spoken of abroad, I will not divulge, reckoning that all such should be kept secret.

While I continue to keep this oath unviolated, may it be granted to me to enjoy life and the practice of the Art, respected by all men in all times! But should I trespass and violate this oath, may the reverse be my lot!

"Life is short;
Art is long;
Experience difficult." – Original inscription on the Aesculapius wand.

REFERENCES

1. *Green, John R.: Medical History for Students, Illinois, Charles C. Thomas Publisher, U.S.A., 1968, p. 3.*
2. *Bettmann, Otto: A Prictorial History of Medicine, Illinois, Charles C. Thomas Publisher, U.S.A., 1962, p. 24.*

(cont. from page 115)

4. R.J. Alfidi, T.F. Meaney, et al., Evaluation of Renal Homotransplantation by Selective Angiography, Radiology, Vol. 1099, No. 87 (1966).
5. T.W. Staple and D.T.C. Chiang, Arteriography following Renal Transplantation, Amer. J. Roentgen., Vol. 669, No. 101 (1967).
6. N.K. Hollenberg, A.B. Retik, and S.M. Rosen, The Role of Vasoconstriction in the Ischemia of Renal Allograft Rejection, Transplantation, Vol. 6, No. 1, pp. 50-60.
7. Ibid.
8. M.H. Flax and B.A. Barnes, The Role of Vascular Injury in Pulmonary Allograft Rejection, Transplantation, Vol. 66, No. 4 (1966).
9. M. Goldberg, Canine Lung Allotransplantation--Function and Pathology, Paper delivered at Annual Meeting of the Royal College of Physicians and Surgeons, January 1976.
10. E.L. Walker, O. Gabriele, and P. Hutchin, Pulmonary Angiography--Sequential Changes during Acute Rejection of Canine Lung Allografts, Journal of Surgical Research, Vol. 10, No. 3 (September 1970), p. 405.
11. S.S. Siegelman and F.J. Veith, Angiography of the Transplanted Lung, Amer. J. Roentgenol., Rad. Therapy and Nuclear Med., Vol. 795, No. 120 (1974).
12. K.W. Cochran, S.B. Doull, and K.P. Dubois, Acute Toxicity of Zirconium, Colombium, Strontium, Lanthanuum, Cesium, Tantalum and Yttrium, Arch. Industr. Hyg., 1950, pp. 637-650.
13. G.L. Burke, The Corrosion of Metals in Tissues, and An Introduction to Tantalum, Can. Med. Assoc. J., Vol. 125, No. 34 (1940).
14. D.A. Nichols and J.A. Colclough, Cranioplasty with Tantalum Plate, Surgery, 1945, pp. 304-314.
15. E.J. Nagy, A. Colin, and J.W. Davidson, Tantalum Angiography in Experimental Hyperacute Renal Xenograft Rejection, Investigative Radiology, Vol. 9, No. 5 (September-October 1974).
16. J.A. Nadel, W.G. Wolfe, and D. Graf, Powdered Tantalum as a Medium for Bronchography in Canine and Human Lungs, Investigative Radiology, Vol. 3, No. 229 (1968).
17. Allan E. Dumont and Anthony Acinapura, Radiopacification by Intravenous Injection of Tantalum Particles, Investigative Radiology, Vol. 7, No. 1, (January - February 1972), pp. 56-60.
18. Lester Grant, Amalia B. Martelli, and Allan E. Dumont, Selective Deposition of Tantalum Particles on Injured Vascular Endothelium, Microvascular Research, Vol. 7 (1974), pp. 376-379.
19. E.J. Nagy, op. cit.
20. Obtained from the Fansteel Corporation, Chicago, Ill.
21. P. G. Croft, Problems of Anaesthesia in the Rabbit, in Small Animal Anaesthesia (Manchester, 1964).
22. W.C. Dolowy and A.L. Hesse, Chlorpromazine Premedication with Pentobarbital Anaesthesia in the Rabbit, J. V. A. M. A., Vol. 134 (February 15, 1959), p. 183.
23. Mean pulmonary artery pressure in dogs was determined by Daicoff to be 20.2 millimetres of mercury. Annals of Thoracic Surgery, Vol. 9, No. 6 (June 1970), p. 569.

Your years at Medical School are the hardest. So how about some help along the way?

Medical Officer Training Plan (MOTP).

A subsidization programme for medical students, known as the Canadian Forces Medical Officer Training Plan, has been approved by the Department of National Defence.

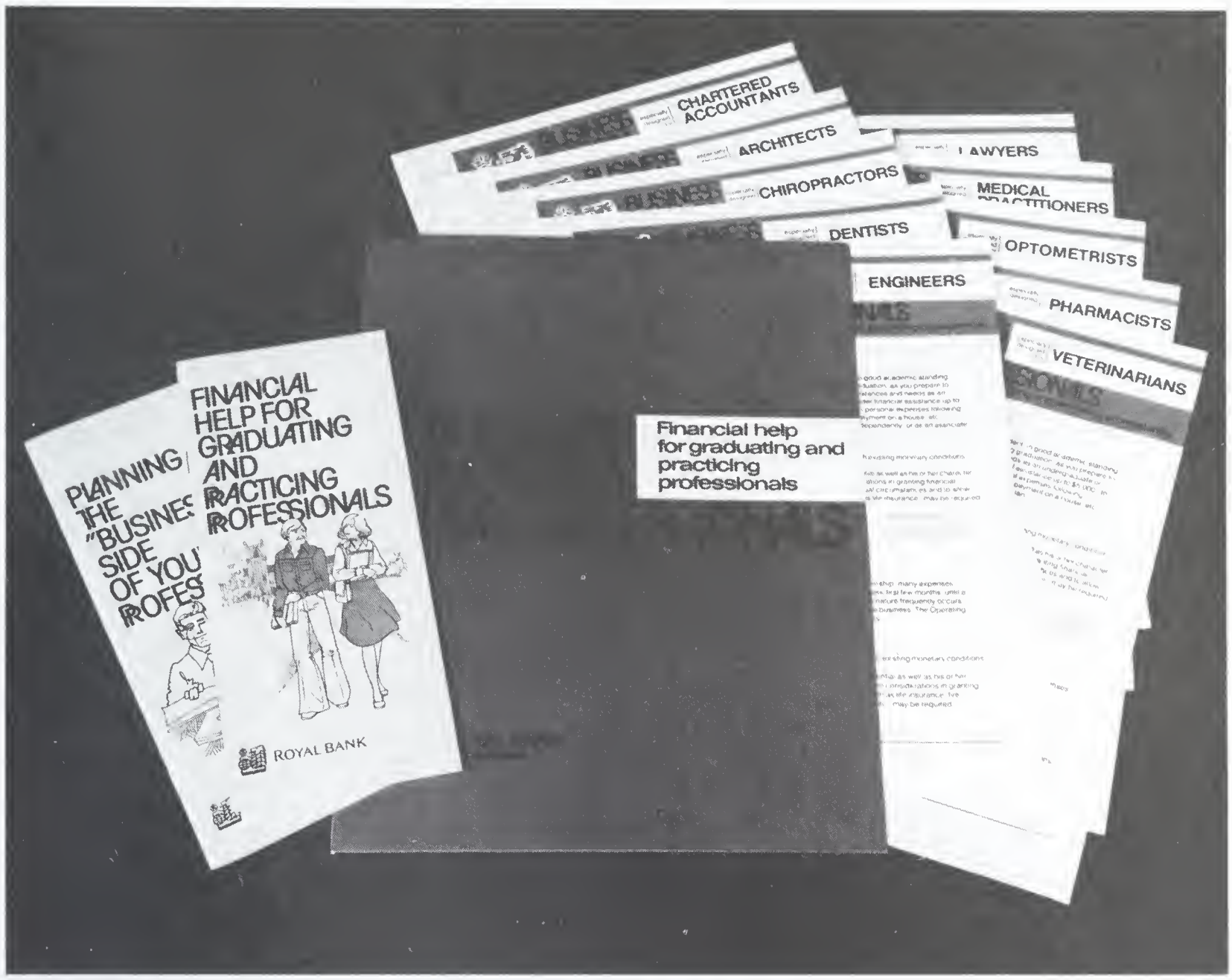
Provisions of the plan.

The Medical Officer Training Plan provides for:

- up to three years academic tuition;
- financial subsidization during your internship;
- monthly pay at 2nd Lieutenant rates for the first, second and third subsidized academic years. Pay during the final intern year is at Lieutenant rates, and upon obtaining your licence, at Captain rates;
- an annual allowance for the purchase of medical books and instruments;
- a substantial allowance for the initial purchase of uniforms;
- 30 days' holiday each year, with pay;
- medical and dental care;
- other benefits and privileges of the Service and a commissioned status;
- a guaranteed position of respect and a good starting salary.

For more information contact your
Canadian Forces Recruiting Centre
25 St. Clair Avenue East
Toronto, M4T 1M2
Telephone: 966-6564

ASK US ABOUT YOU. **THE CANADIAN ARMED FORCES.**



PROFESSIONALS SOMETIMES NEED TO SEEK MORE THAN JUST ADVICE.

All the good advice in the world won't pay the rent on office space, or keep the cash flow of an expanding practice running smoothly.

If you're a graduate, or have already started your career, the Royal Bank can help you to either get established, or progress further in the professional world. Your Royal Bank manager is qualified to give you good financial advice, and assistance in a more tangible form–up to $50,000 where the circumstances warrant.

Speak to your Royal Bank manager about our Business Program for Professionals. Whether you're just starting out, or on your way up, he can help you plan your future with practical solutions to your financial problems.

ROYAL BANK
the helpful bank

Eligible professions include: Accounting–Chartered Accountant–C.A., Architecture–B. ARCH., Chiropractic–Doctor in Chiropractic–D.C., Dentistry–D.D.S., Engineering–B. ENG., Law–B.C.L., LL.B., Medicine–M.D., Optometry–O.D., Pharmacy–B. Sc., PHARM., Veterinary Medicine–D.V.M. ...and others.